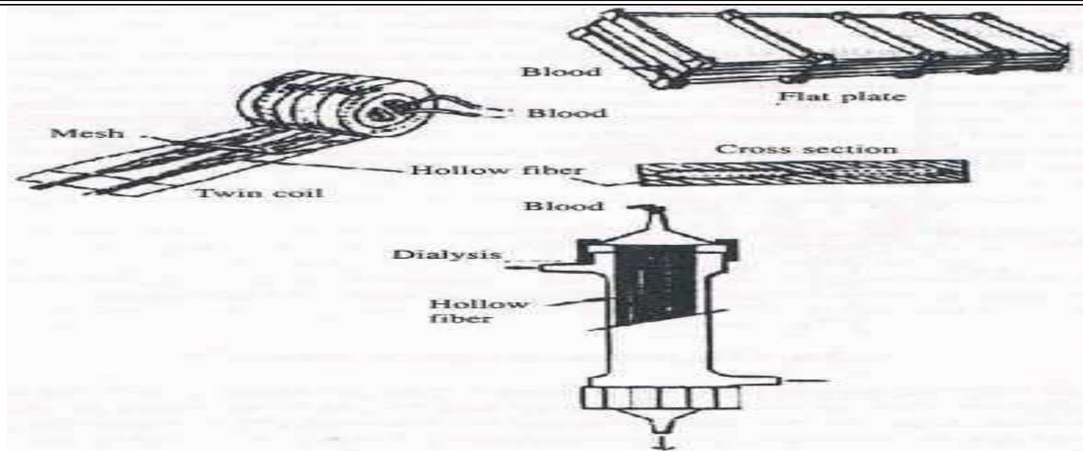
WINTER– 2018 EXAMINATION

Model Answer **Subject Code:** 17543

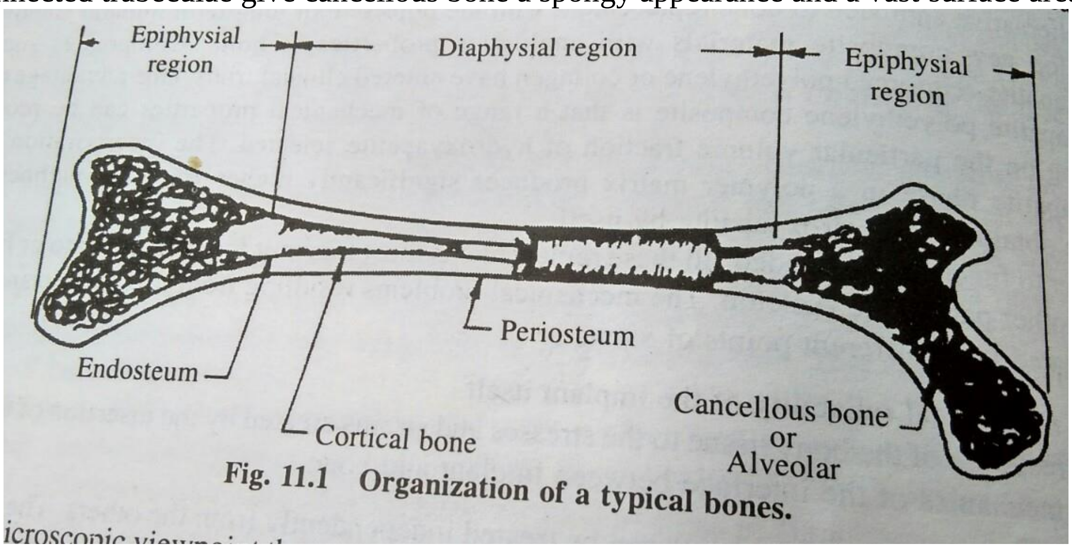
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical spelling errors should not be given more Importance Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.	**A**	**Attempt any THREE**	**12**
	a	**List any four Bonds present in Biomaterials.** **Ans:** **Bonds present in Biomaterials:** 1. Vander Waals 2. Hydrogen 3. Metallic 4. Ionic 5. Covalent	**04 M**
	b	**List any four properties of alumina.** **Ans:** **Properties of alumina:** 1. It is insoluble in water & slightly soluble in strong alkali and acid. 2. Chemically stable and excellent corrosion resistant. 3. High melting point. 4. Highest hardness. 5. Highest mechanical strength 6. Good biocompatibility. 7. High wear resistance & reasonable strength.	**04 M**
	c	**List different types of dialyzers & draw any one.** **Ans:** **Types of dialyzers** 1. Flat plate 2. Coil-type 3. Hollow fiber	**02 M**

		 **Fig: Types of dialyzers**	**02**
	d	**List the materials used for Filling & Restoration.** **Ans:** **Dental filling material:** 1. Gold foil. 2. Platinum. 3. Aluminum. 4. Lead and tungsten. 5. Tin and iron. **Dental restoration material:** 1. Amalgam: is a metallic filling material composed from a mixture of mercury (from 43% to 54%) and powdered alloy made mostly of silver, tin, zinc and copper, commonly called the amalgam alloy 2. Composite resin (also called white fillings) 3. Glass Ionomer Cement 4. Resin modified Glass-Ionomer Cement (RMGIC)	**02 M** **02 M**
	B	**Attempt any ONE**	**06**
	a	**Describe the testing and evaluation procedure for dental implants.** **Ans:** The testing and evaluation of dental implants involves several stages. 1. First, materials are tested for toxicity by implantation subcutaneously in rats for periods of time up to 30 days and through tissue culture tests. 2. The second step is to test the devices in an animal model. Of all animals, the baboon is considered the most preferred experimental animal in dental-implant studies, since its physiology and immunological responses are very similar to those of humans. 3. In general, the clinical condition of dental implants is evaluated by using radiographs, gingival tone, pocket depth and mobility. A stereo-photogrammetric method of measuring the extent of tissue changes and mobility of Subperiosteal implants technique utilizes stereo photographs to measure quantitatively, the extent of tissue swelling or resorption, as well as, migration of dental implants to an accuracy of 16 µm.	**06 M**
	b	**Describe the structure of typical bone with its diagram.** **Ans:** **Structure of typical bone:** Long bones are consists of two major regions: compact or cortical bone and cancellous or trabecular bone. The location of these bone types in a femur shown in fig.	

Cortical or compact bone is a dense material with a specific gravity of about 2. The external surface of bone is generally smooth and is called the periosteum. The interior surface is called Endosteal surface, which is roughened. Cancellous bone, which exists in epiphysial and metaphysical regions of long bone, is also called spongy or trabecular bone because it is composed of short struts of bone material called trabeculae. The connected trabeculae give cancellous bone a spongy appearance and a vast surface area. **03 M**



03 M

Fig: Structure of typical bone

2. **Attempt any <u>FOUR</u>** **16**

a **Describe contact angle technique used in surface analysis.**

Ans:

Description of contact angle technique:

When a liquid drop is placed onto a solid surface or another liquid surface two things may happen. The liquid may sit on the surface in the form of a droplet or it may spread out over the entire surface. Which event occurs depend on the interfacial free energies of the two substances. At equilibrium contact angle or Young-Dupree equation describes: $\gamma s/g = \gamma s/l + \gamma l/g \cos \theta$, where $\gamma s/g$, $\gamma s/l$ and $\gamma l/g$ are the interfacial free energy between the solid and gas; solid and liquid, liquid and gas respectively and θ the contact angle. **04 M**

b **Draw neat labelled stress-strain curve and explain it.**

Ans:

Stress-strain curve:

In Stress-Strain curve x-axis represent strain and y-axis represent stress. The stress is force per unit cross-sectional area and strain is change in length per original length. The ability of material to withstand static load can be determined by a standard tensile, compressive and shear tests. From a load-displacement curve a stress-strain diagram can be constructed by knowing cross-sectional area and length of rod. The stress-strain curve of a solid can be demarcated by the yield point or stress (YS) into elastic and plastic regions. In the elastic region, the strain increases in direct proportion to the applied stress whereas in the plastic region strain changes are no longer proportional to the applied stress. Further when the applied stress is removed, the material will not return to its original shape but will be permanently deformed. This phenomenon is termed as plastic deformation. The peak stress in fig. is often followed by an apparent decrease until a point is reached where the material ruptures. The peak stress is called as the tensile or ultimate tensile strength (TS or UTS) and the final stress **02 M** where failure occurs is called the failure or fracture strength (FS). Hardness is the measure of plastic deformation and is defined as the force per unit area of indention or penetration and thus has the dimension of stress. A material that can withstand high stresses and will undergo considerable plastic deformation (ductile-tough material) is tougher than the one that has high capacity for deformation but can only withstand relatively low stress (ductile soft).

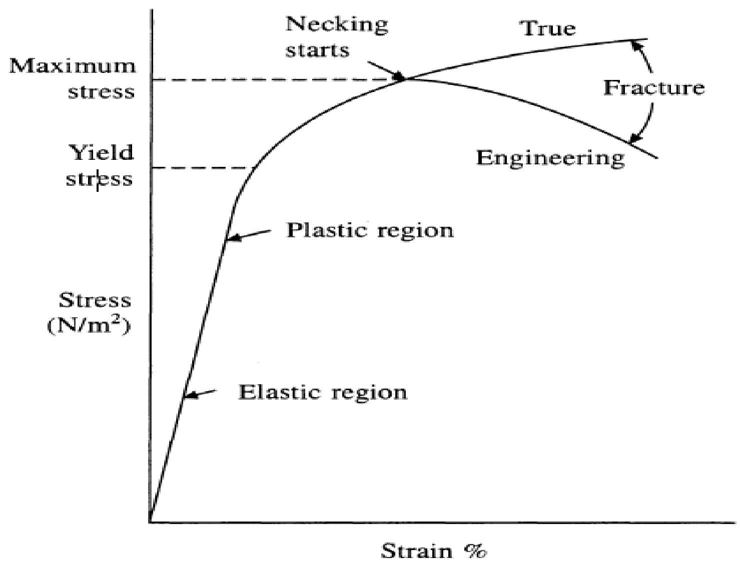


Fig: Stress-strain curve

02 M

c **Give composition and any two properties of Nitinol.**

Ans:

Element	Composition (%)
Nickel	54.01
Cobalt	0.64
Chromium	0.76
Manganese	0.64
Iron	0.66
Titanium	Balance

Table: Composition of Nitinol

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Properties of Nitinol:

1. Good biocompatibility and corrosion resistance.
2. The low modulus of elasticity.
3. Good fatigue property.
4. High acoustic damping property.
5. Shape memory effect.

02 M

d **Explain the biological tolerance of any four implant metals.**

Ans:

Biological tolerance of implant metals:

Iron: The adult human body contains approximately 4 to 5 g of iron. Metabolically active iron is contained in circulating hemoglobin (about 66%), myoglobin (3%) and in heme containing enzymes less than 10% or is attached to transferrin in transit through the plasma. The remainder is held in storage either in ferritin, which is found in greater quantities in the liver, spleen and bone, or it is stored as insoluble intracellular granules of hemosiderin. The balance of iron in the body is maintained by adsorption at approximately 1mg/day, with a similar quantity being lost per day.

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		Cobalt: It is an essential trace element and the function is confined to its role in vitamin B12. A daily intake of 3μm of vitamin B12 is adequate. Free cobalt has no obvious function and there is no apparent mechanism for controlling its uptake into or loss from the body. Eighty percent of dietary intake is unabsorbed and excreted in the faces unabsorbed and urinary excretion of the remainder is relatively fast. In cases of raised dietary cobalt levels it is possible for the cobalt absorbed to be located in the muscles of the heart leading in some cases to cardiomyopathy. It is not a particularly toxic metal and although there are theoretical and experimental grounds for assuming that cobalt based alloys could be quite toxic upon implantation, there is little evidence that they have any adverse effects on implantation in humans. Indeed these alloys offer very good biocompatibility properties, largely on account of the excellent corrosion resistance. **Chromium:** Like many of the transition metals, chromium is both an essential dietary element that is required in low concentrations (blood level average 2.8μg/IOO g) and also a toxic substance if present in the raised amounts. Chromium compounds are only poorly absorbed after oral ingestion and storage of chromium (III) is largely confined to the reticuloendothelial systems. The hexavalent chromium ion is able to pass the plasma membrane freely, both in and out of the cell and the reduction takes place mainly in the mitochondria. The mechanism of chromium toxicity is not entirely clear but it has been suggested that the in vivo reduction from hexavalent to trivalent states may be important. **Molybdenum:** It is an essential dietary element and has its highest concentration in the liver at 1 to 3 ppm. It is necessary for the function of certain enzymes. There are three principal molybdenum containing metallo-enzymes: xanthine oxidase, aldehyde oxidase and sulfite oxidase. In contrast to many metals, molybdenum is quite readily absorbed from the intestinal tract, excretion largely being via the kidneys. Molybdenum is toxic in large doses; the symptoms of toxicity include diarrhea, coma and cardiac failure, and inhibition of activity of ceruloplasmin, cytochrome oxidase, glutaminase, and choline esterase and sulfite oxidase. High levels of molybdenum can also interfere with calcium and phosphorus metabolism. **Nickel**: It is an essential element of limited biological activity with a wide-ranging distribution. In humans, it has a level of approximately 10 mg in adult human tissues. A normal blood level of nickel is around 5mg/l. In human inhalation of nickel may lead to renal effects but observation of toxicity are largely confined to carcinogenesis and hypersensitivity. It is sufficient to note here that nickel carcinogenesis in experimental animal is well established. While these facts are of some concern, their reference to implantation is not yet clear. Contact dermatitis for nickel and nickel alloys has been well established. **Manganes**e: It is at a level of 12 to 20 mg in a 70 kg man, and the normal blood level is 7.0 to 28.0μg/ml. A higher concentration of manganese occurs in pituitary gland, pancreas, liver, kidney and bones, and accumulation occurs in hair. Within the cell manganese is associated with the mitochondria and it is largely protein bound in plasma. It is a co-factor for a number of enzymes; among them are carboxylases and phosphatases. Manganese is one of the least toxic trace elements. The divalent form is supposed to be more toxic than trivalent form. It has been shown that injected manganese elimination from the human body can be described by a curve with two exponents, the more rapid pathway having a half-life of 4 days while 70% of the manganese had an average half-life of 39 days. **Titanium:** Unlike nickel, titanium has a very good reputation for biocompatibility. Titanium and its compounds are not carcinogenic in experimental animals or in humans.	**01 M** **01 M** **01 M**
	e	**Describe intrinsic pathway of formation of blood clot.** **Ans:**	

Intrinsic pathway of formation of blood clot:

The contact activation pathway (Intrinsic) begins with formation of the primary complex on collagen by high-molecular-weight kininogen (HMWK), prekallikrein, and FXII (Hageman factor). Prekallikre in is converted to kallikrein and FXII becomes FXIIa. FXIIa converts FXI into FXIa. Factor XIa activates FIX, which with its cofactor FVIIIa form the tenase complex, which activates FX to FXa. The minor role that the contact activation pathway has in initiating clot formation can be illustrated by the fact that patients with severe deficiencies of FXII, HMWK, and prekallikrein do not have a bleeding disorder. Instead, contact activation system seems to be more involved in inflammation. **04 M**

f **Give composition of teeth. Give its mechanical properties.**

Ans:

Constituents[a]	*Dentine*	*Enamel*
Ca^{2+}	27.0	36.0
PO_4^{3-} as P	13.0	17.7
Na^+	0.3	0.5
K^+	0.05	0.08
Mg^{2+}	1.1	0.44
CO_3^{2-}	4.5	2.3
F^-	0.05	0.01
Cl^-	0.01	0.30
$P_2O_7^{4-}$	0.08	0.022
Ash[b]	70	97.0
Organic	20	1.0
H_2O[c]	10	1.55

Table: Composition of teeth **02 M**

	Density (g/cm^3)	**Compressive Strength (Mpa)**	**Young's Modulus (GPa)**	**Thermal Conductivity(W/mk)**
Enamel	2.2	241	48	0.82
Dentin	1.9	138	13.5	0.59

Table: Mechanical properties of teeth **02 M**

3. **Attempt any <u>FOUR</u>** **16**

a **Give classification of biomaterials.**

Ans:

Polymers		**Metals**	**Ceramics**	**Composites**
Synthetic polymers	**Biopolymers**			
Polyurethanes, PTFE, Polyethylene, Polypropylene, Polyacrylate, PMMA, PHEMA, Hydrogel, Silicon rubber.	Collagens, Elastin, Mucopolysaccharides Cellulose, Proteoglycans, Chitin.	Stainless steel, Cobalt chromium alloys, Titanium.	Carbons, Alumina, Zirconia, Resorbable ceramics.	Fiber reinforced, Particle reinforced.

Table: Classification of biomaterials **04 M**

b **Write a note on testing of biomaterials.**

Ans:

In vitro method to test biomaterials:

1. **Tissue culture:** The growth of portion of the intact tissue without prior cellular

		dissociation. This method usually utilizes a substrate rather than a suspected technic; exposure to biomaterial is similar to that for true cell culture. 2. **Cell culture:** Roth of initially free dissociated cell. These cells may be grown in to solution or on ager or other media substrate. Exposure to biomaterials may be through direct contact with the bulk materials, contact through an ager. 3. **Organ culture:** The growth of intact organ in vitro. This may vary from the use of fetal bone implant, which can survive without external support system to the use of whole, adults, perfused organs such as kidney or heart. 4. **Blood contact test:** Materials problem in cardiovascular devices are primarily those of inadequate biological performance. This is due to the acute nature of host response. These tests are generally comparative type and examine either coagulation times or homeless rate in either static or dynamic system during or after contact with the foreign material. **In vivo method to test biomaterials:** After in vitro test techniques to test new implant materials in extended times whole animal test is done. The site chosen is usually soft tissue. For joint replacement application, implantation is also performed in cortical bone. Specialized site such as the corneas are used for materials for limited applications. Commonly used expected applications are rabbit, dog, cat, sheep, goat, etc. Most popular sites are: Subcutaneous, Intramuscular, Intraperitonial (E. g. Supraspinatus), Transcortical (E.g. Femur), and Intramedullary (E.g. Femur and tibia). Tests are divided into two types: 1. **Non Functional Test:** Implant is of arbitrary shape, perhaps in the form required for later mechanical tests of material response and floats passively in the tissue site. Focus on direct interaction between the substance of the material and chemical and biological species of the implant environment. 2. **Functional Test:** Test of this type is obviously of much greater complexity and cost than the nonfunctional type. For total joint replacement, design of implant would be as per the animal requirement. Design, fabrication, mechanical testing and implantation may be more difficult than final production of device for human use. In addition to implantation, it is required that material be placed in functional mode with its wide experience in human implant service. Total hip joint replacement design has been made and tested in cats, dogs, sheep and goat.	**02 M** **02 M**
	c	**Give any two biomedical applications of following polymers:** **i. Hydrogel** **Ans:** **Applications of Hydrogel:** 1. It is used for synthetic articular cartilage in reconstructive joint surgery. 2. It is used in drug delivery system. 3. Making maxillofacial implants for jaw and chin augmentation. 4. It is used for making artificial skin. 5. It is used in making contact lenses. **ii. Carbon** **Ans:** **Applications of Carbon:** 1. Carbon coatings are used for making heart valves, blood vessel grafts and percutaneous devices. 2. The chronic stimulation of the cochlea for artificial hearing. 3. Stimulation of the cortex. 4. Dental implant.	**02 M**

5. Tissue Regeneration.
6. Drug delivery system.
7. Reduction in critical surface tension and blood adhesion.
8. Ultra low Temperature Isotropic Carbons (ULTI) coated valves are most widely used.

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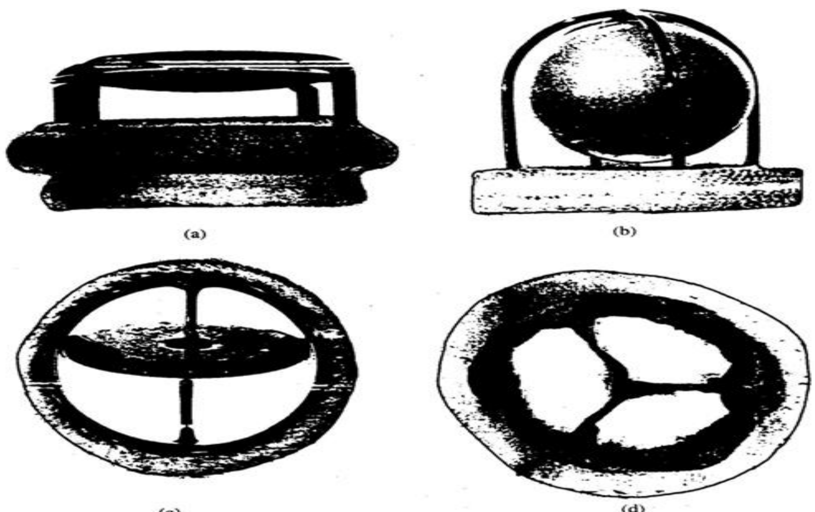
d **List four types of prosthetic heart valves and draw any two of them.**

Ans:

Types of prosthetic heart valves:

a) Disk - in - cage
b) Ball - in - cage
c) Tilting disk
d) Porcine aortic valve

02 M



A designs of prosthetic heart valves: (a) disk-in-cage, (b) ball-in-cage, (c) tilting disk and (d) porcine aortic valve).

Fig: Prosthetic heart valves

02 M

e **List different materials used for total joint replacement.**

Ans:

Metals	**Ceramics**	**Polymers**	**Composites**
Stainless steel 316L, Cobalt -based alloys Cast Co- Cr-Mo, Wrought Co.-Ni-Cr-Mo, Wrought Co-Cr-W-Ni, Titanium based materials Cp- Ti, Ti-6Al-4V, Ti-5Al-2.5Fe, Ti-Al-Nb.	Bio inert, Carbon, Alumina, Zirconia, Calcium phosphate, Bioglass.	PMMA, UHMWPE/HDPE, PE, PTFE, Polysulfolene.	Polymer-based, Polysulfolene-carbon, Polycarbonate-carbon, Polysulfone-Kevlar, Polycarbonate-Kevlar.

Table: Materials used for total joint replacement

04 M

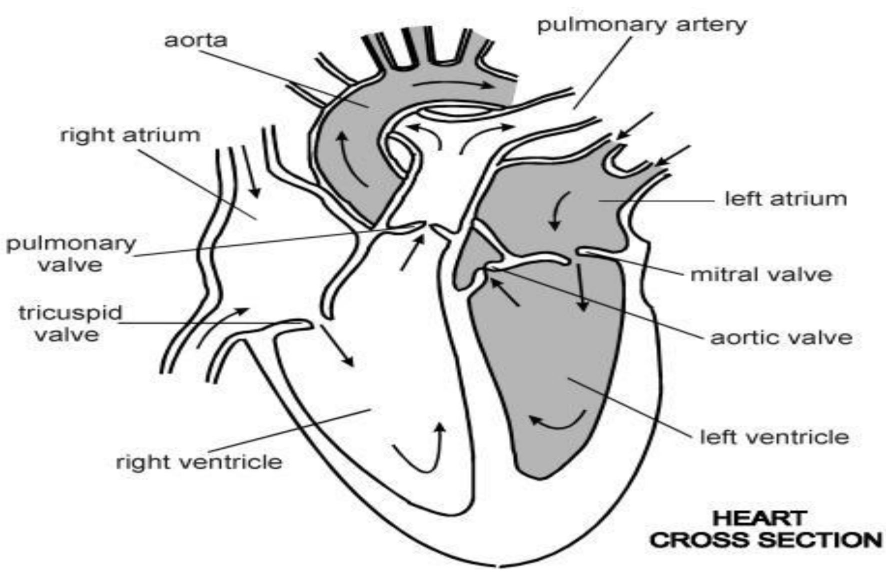
4. **A** **Attempt any <u>THREE</u>** **12**

a **Describe electrokinetic theory in surface analysis.**

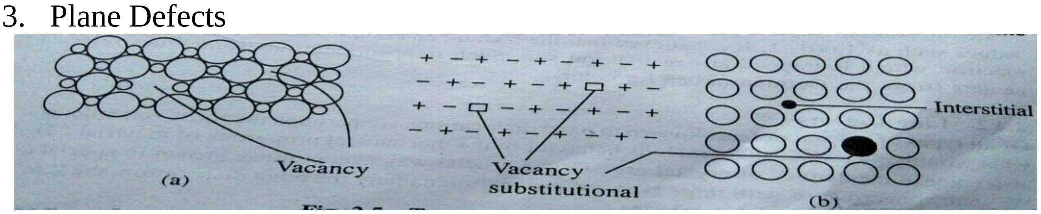
Ans:

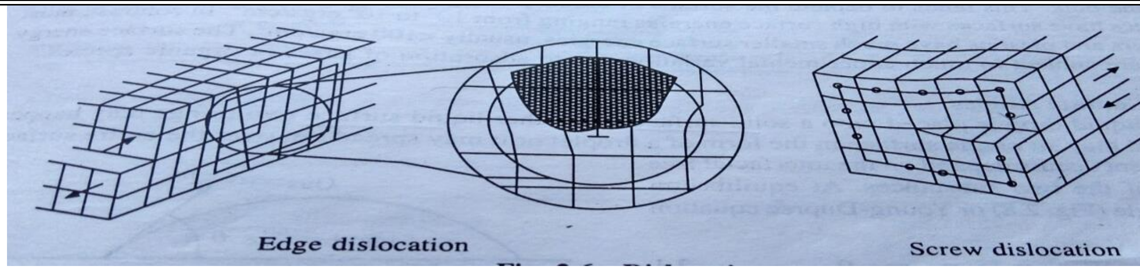
Electrokinetic theory:

When a material with a charged surface is placed in a solution with ions, a diffused layer of oppositely charged ions (counter ions) appears close to the surface. The electrical double layer is the Stern theory, which describes the change in potential Ψ as the distance from the surface increases. The distance from the surface is Debye length γ.

		Materials acquiring charge due to many reasons, example: Metals develop a surface potential due to surface oxidation. The presence of the electrical double layer gives rise to electrokinetic phenomena when either the particles or the medium moves. The streaming potential and electro osmosis owe their existence to the electrical double layer. Electro osmosis is observed when an electrical potential is applied to the opposite ends of porous plug in a liquid medium. A flow of liquid through plug occurs. The streaming potential is the converse. Forced motion of liquid through a porous plug generates an electrical potential, called Zeta potential (ζ). The Zeta potential is the electrical potential at the plane of shear in the liquid. Measurements of ζ potential have been useful for determining characteristics of blood vessels. The surface properties are among the most important material properties that a biomaterial possesses. This is due to the fact that when a device is implanted into tissues, the surface chemistry will determine to a large extent how the material and the tissues, or fluids interact.	**04 M**
	b	**Write any four applications of silicon rubber.** **Ans:** **Applications of silicon rubber:** 1. Used to make catheters. 2. Replacement of destroyed or diseased finger joints. 3. Replacement of carpal bones, toe prostheses and capping temporomandibular joints. 4. Breast augmentation. 5. Maxillofacial surgery (includes nasal supports, jaw augmentation, orbital floor repair, and chin augmentation). 6. Artificial bladder, sphincters and testicles. 7. Making artificial heart valves. 8. Drug delivery system. 9. Middle ear prosthesis.	**04 M**
	c	**Draw neat labelled diagram of heart.** **Ans:**  **Fig: Heart**	**04 M**
	d	**Describe the concept of bone healing.** **Ans:** **Concept of bone healing:** Upon bone fracture a certain sequence of cellular events is observed for	

		healing bones. There are basically three types of cellular activities : 1. Fibroblastic 2. Chondroblastic 3. Osteoblastic Fibroblast from the periosteum and surrounding tissues proliferate vigorously into the region of fracture within 1 or 2 days. During the same period capillaries being proliferating into the wound invading the fibrous callus prior to actual new bone formation. Within the first week osteogenic cells begin to migrate from the peripheral regions towards the bone fracture. After about a week, the level of mucopolysaccharides begins to decrease while collagen production by fibroblasts, chondroblasts and osteoblasts becomes significant. In a little more than 1 week collagen fibers bridge the entire gaps of the fracture and the pH returns to normal. Osteoblasts begin to form new trabecular bone in the marrow. After 2 weeks a collagen matrix replaces the entire clot and chondroblasts are seen in the region between the matrix and the advancing bone growth. After a week or two the uptake of calcium and phosphorous into the wound area increases which is attributed to the increased rate of bone mineral deposition. By the third and fourth weeks the major activity is the replacement of chondroblasts by trabecular bone and after 5-6 weeks the major activity is the remodeling of the bone trabeaculae with the deposition of compact bone.	**04 M**
	B	**Attempt any <u>ONE</u>**	**06**
	a	**List any four applications of collagen in dentistry.** **Ans:** **Applications of collagen in dentistry:** 1. Prevention of oral bleeding 2. Support of regeneration of periodontal tissues 3. Promotion of healing of mucosal lining 4. Prevention of migration of epithelial cells 5. Dressing materials 6. Carrier substance for immobilization of various active substances used in dentistry. 7. Decreased seepage of blood during periodontal mucoginvival surgery.	**06 M**
	b	**Write a short note on knee-joint repair.** **Ans:** The knee-joint repair consists of: 1. The Knee Joint 2. Repair of Anterior Cruciate Ligament 3. Total Knee Replacement **The Knee Joint:** Anatomy and physiology of knee joint is more complicated than a hip because of the complex loading pattern of the knee. The knee consists of three long bones, the femur, tibia and fibula and a smaller bone, the patella. These bones are held together by ligaments. The lower end of the femur is expanded to form a curved surface which is covered with articular cartilage. Cartilage to cartilage contact between femur and tibia occurs at two separate locations that are separated by a grove by which anterior and posterior cruciate ligaments (ACL and PCL respectively) are found. ACL and PCL hold these bones together. The fibula is attached to the femur with tibial collateral ligament and to the capsule of the tibia fibular joint. The capsule is filled with synovial fluid that bathes the articulate surface of each bone and maintains a low coefficient of friction between the two surfaces. Synovial fluid is essentially a dialysate of blood	**02 M**

		plasma with added hyaluronic acid. The quadriceps femories muscle and patellar bone are attached through the patellar tendon/ligament. The muscular contractions and length changes in the appropriate muscles transfer the energy to tendons, which results in translation and rotation of bones of the knee. Thus the motion of the tibio-femoral joint is due to a combination of translation and rotation. **Repair of Anterior Cruciate Ligament:** At present time, repair of anterior cruciate ligament (ACL) is not popular. The primary problem is the approach to the ligament. If both of the menisci are normal, many groups debride the anterior cruciate and rehabilitate the knee. If one or both of menisci are torn, then one must direct attention to the possibility of ligament repair or reconstruction. Replacement can be accomplished using Autografts or devices containing synthetic polymers. The reconstruction of the ACL using autogenous tissues including illiotibial band, semitendinous, patella and gracilis tendons and meniscus. When biologically grafts are not available, the replacement of ACL can be achieved using a number of medical devices made of synthetic materials that are conditionally approved for clinical use. These include augmentation devices obtained from carbon fiber, Dacron, Teflon, and braided polyethylene. **Total Knee Replacement:** The femoral component consists of a fairly thin, rigid shell with an attached fixation system to bone. The geometry of the femoral shell requires a stiff, high strength, low wear rate material such as metal. The femoral component is fixed to the cortical bone of the femoral shaft. The fixation system may be either PMMA cement or a biological ingrowth type. The tibial portion consists of a broad plateau covering the tibia, consisting of a stiff metal tray supporting a polymeric or fiber reinforced polymer. Repeated tensile loading may cause failure of PMMA-bone interface TKR utilizes a limited number of metallic alloys including cobalt-chromium and titanium alloy. Cobalt-chromium alloy combined with ultrahigh molecular weight polyethylene (UHMWPE) remains the contact surfaces of choice, despite some adverse effects on biocompatibility and mechanical problems. These include creep and fatigue of UHMWPE component due to high stresses and repeated loading and wear of polymeric contact surface due to adhesion of the polymeric surface to the metal. High stresses and repeated loading and wear of polymeric contact surface due to adhesion of the polymeric surface to the metal.	**02 M** **02 M**
5.		**Attempt any <u>FOUR</u>**	**16**
	a	**List three imperfections in crystal and sketch any one.** **Ans:** **Imperfections in crystal:** 1. Point defects 2. Line defects 3. Plane Defects  **Fig: Point defects**	**02 M** **02 M**

		 **Fig: Line defects**  **Fig: Plane defects**	
	b	**Enlist the properties of zirconia and write any two applications of it.** **Ans:** **Properties of Zirconia:** 1. Use temperatures up to 2400°C 2. High density 3. Low thermal conductivity (20% that of alumina). 4. Chemical inertness. 5. Resistance to molten metal's. 6. Ionic electrical conduction. 7. Wear resistance. 8. High fracture toughness. 9. High hardness. 10. High refractive index. 11. Excellent biocompatibility and wear properties. 12. Fine grain size, lack of surface roughness. **Applications of Zirconia:** 1. Dental implants. 2. Shoulder prosthesis. 3. Knee and hip replacements. 4. Orthopedic prosthesis. 5. Middle-ear reconstruction. 6. Oral therapy in the treatment of hyperkalemia.	**02 M** **02 M**
	c	**Give any four biomedical applications of stainless steel.** **Ans:** **Applications of stainless steel:** For making: 1. Hip nails 2. Bone plates 3. Intramedullary pins 4. Heart valves 5. Cardiac pacemaker electrodes 6. Screws 7. Nuts, bolts 8. Orthopedic implants (knee, hip, ankle joint replacement).	**04 M**

	d	**Write a short note on temporary fixation device.** **Ans:** **Temporary fixation device:** Temporary fixation of joints can be achieves by implementing temporary fixation devices. The purpose of temporary fixation devices is to stabilize fractured bone until natural healing processes have restored sufficient strength so that the implant can be Removed. These devices include pins, nails, wires, screws, plates, and intramedullary devices. 1. Screws are used with the plates to secure them to the bone. 2. Nuts can be used to keep the screw or pin from pulling out of bone. 3. Bolts are also used to compress bone, as in the case of the tibial bolts, which are used for displaced, split fractures of the tibial plateau. 4. Plates are used for joining bone fragments together during healing of load-bearing bones. The plate provides rigidity for the fixation of the fracture. 5. Wires used to provide temporary stabilization during operation. 6. Pins may be used for intramedullary fixation (Used for fixation of fractures). 7. Nails used to prevent rotation and shortening, particular fractures.	**04 M**
	e	**Metals are less biocompatible than polymers. Justify your answer.** **Ans:** **Metals are less biocompatible than polymers:** Metallic implants can fail due to fracture loosening or corrosion. A corrosion cell may be developed near the implant due to variety of reason. It releases significant concentration of corrosion products in solution. Polymers are usually in a lower energy state than metals and therefore do not interact with other molecules including tissues. The metals lower their chemical potential by reacting with other materials.	**04 M**
	f	**Give mechanical properties of bone.** **Ans:** (see table below)	**04 M**

	Direction of test	Modulus of elasticity (Gpa)	Tensile strength (Mpa)	Compressive strength (Mpa)
Leg bone	Longitudinal			
Femur		17.2	121	167
Tibia		18.1	140	159
Fibula		18.6	146	123
Arm bones	Longitudinal			
Humerus		17.2	130	132
Radius		18.6	149	114
Ulna		18	148	117
Vertebrae	Longitudinal			
Cervical		0.23	3.1	10
Lumbar		0.16	3.7	5
Spongy bone		0.09	1.2	1.9
Skull	Tangential Radial	-	-	- 97

Table: Mechanical properties of bone

6.		**Attempt any FOUR**	**16**
	a	**Draw figure of bone healing assisted by resorbable bone plate and describe it.**	

Ans:

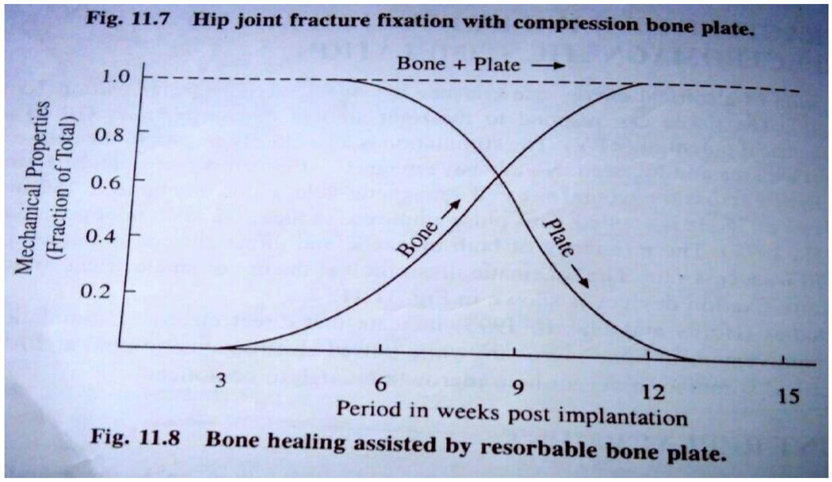


Fig: Bone healing assisted by resorbable bone plate

02 M

The purpose of temporary fixation device is to stabilize fractured bone until natural healing processes restored sufficient strength so that the implant can be removed. These devices include pins, nail, wires, screws, plates and intramedullary devices. Bone plates are used for joining bone fragments together during healing of load bearing bones. The plate provides rigidity for fixation of the fracture. Screws are used with the plates to secure them to the bone. There are different types and sizes of fracture plates. The force generated by the muscles in the limbs are very large ,femoral and tibial plates must be very strong.one major drawback of the healing by rigid plate fixation is the weakening of the underlying bone such that refracture may occur following removal of the plate. This is largely due to the stress shield effect. Therefore new material are being evaluated for fabrication of plates with a low axial stiffness and moderate bending and torsional stiffness to facilitate fracture healing without bone atrophy. Another approach is to use a resorbable material for bone plate. As the strength of the fracture site increases due to healing processes, the resorption of the implant begins to take place. The gradual reduction of strength of implant transfers an increasingly larger percent of the load to the healing bone .The degration products of such plates must be biocompatible .the design aspect must involve producing the appropriate combination of initial strength and time dependent performance through the variation in absorption rate and microstructure. There is no need for second operation in removing these plates.

02 M

b **Draw structure of eye.**
Ans:

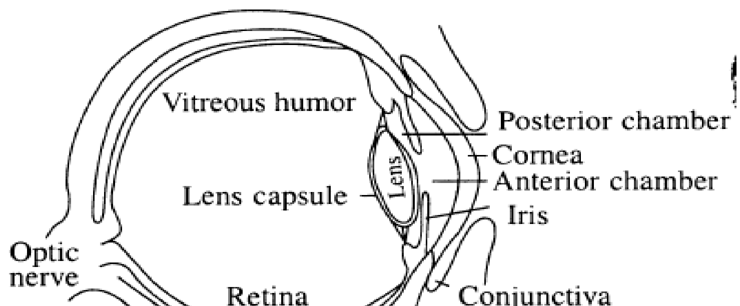
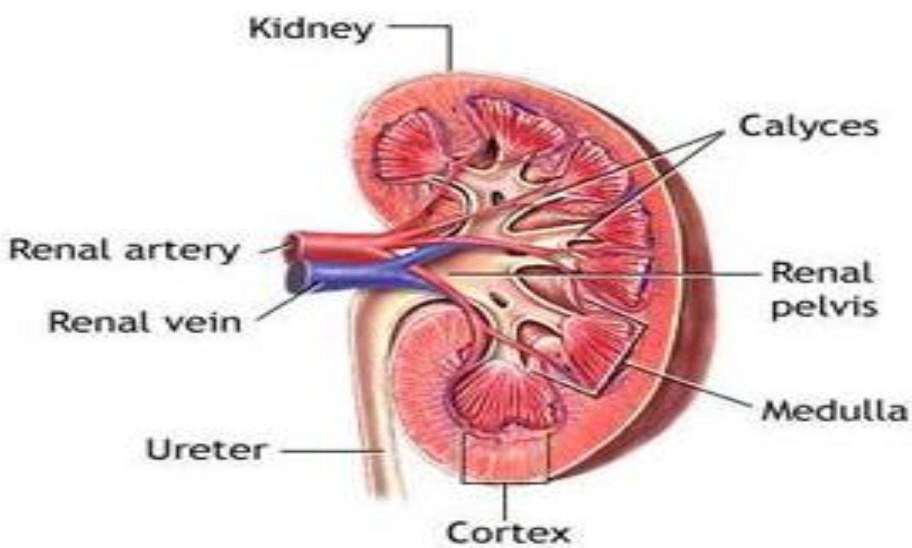


Fig: Structure of eye

04 M

	c	**State the function of eye-shield and list polymers used for optical implant.** **Ans:** **Function of eye-shield:** These are used in the treatment of basement membrane associated diseases, corneal abrasion and erosion, epithelial defects, cataract extraction, penetrating keratroplasty and other diseases that cause eye inflammation. **List polymers used for optical implant:** 1. PMMA 2. PHEMA 3. Silicone 4. Bioglass 5. Polypropylene.	**02 M** **02 M**
	d	**State the need of cardiac pacemaker.** **Ans:** **Need of cardiac pacemaker:** The rhythmic beating of the heart is due to triggering pulses that originate in an area of specialized tissue in the right atrium of the heart. This area known as the Sino-arterial node. In abnormal situation, if this natural pacemaker cases to function or becomes unreliable or if the triggering pulse does not reach heart muscle because of blocking by damaged tissues, the natural and normal synchronization of the heart action gets disturbed. When monitored, this manifests itself through a decrease in the heart rate and changes in the ECG waveform. By giving external electrical stimulation impulses to the heart muscle, it is possible to regulate the heart rate. These impulses are given by an electronic instrument called a pacemaker.	**04 M**
	e	**Draw a neat labelled structure of kidney.** **Ans:**  **Fig: Structure of kidney**	**04 M**